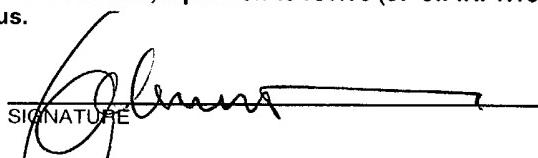


FORM PTO-1390 (REV 11-2000)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 2490-17
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 101070619	
INTERNATIONAL APPLICATION NO. PCT/GB00/03483	INTERNATIONAL FILING DATE 08/09/2000	PRIORITY DATE CLAIMED 08/09/1999	
TITLE OF INVENTION SEMICONDUCTOR LASER DIODE WITH A DISTRIBUTED REFLECTOR			
APPLICANT(S) FOR DO/EO/US MASSARA, A. et al.			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
1.	<input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.		
2.	<input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.		
3.	<input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.		
4.	<input checked="" type="checkbox"/> The U.S. has been elected by the expiration of 19 months from the priority date (Article 31).		
5.	A copy of the International Application as filed (35 U.S.C. 371(c)(2)).		
a.	<input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).		
b.	<input checked="" type="checkbox"/> has been communicated by the International Bureau.		
c.	<input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).		
6.	<input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).		
a.	<input type="checkbox"/> is attached hereto.		
b.	<input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).		
7.	<input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))		
a.	<input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).		
b.	<input checked="" type="checkbox"/> have been communicated by the International Bureau.		
c.	<input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.		
d.	<input type="checkbox"/> have not been made and will not be made.		
8.	<input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).		
9.	<input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).		
10.	<input type="checkbox"/> A English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).		
Items 11 To 20 below concern document(s) or information included:			
11.	<input type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.		
12.	<input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.		
13.	<input checked="" type="checkbox"/> A FIRST preliminary amendment.		
14.	<input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.		
15.	<input type="checkbox"/> A substitute specification.		
16.	<input type="checkbox"/> A change of power of attorney and/or address letter.		
17.	<input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.		
18.	<input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).		
19.	<input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).		
20.	<input checked="" type="checkbox"/> Other items or information. PTO Form 1449		

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER																				
10200619 Unknown	PCT/GB00/03483	2490-17																				
21. <input checked="" type="checkbox"/> The following fees are submitted:		CALCULATIONS PTO USE ONLY																				
BASIC NATIONAL FEE (37 C.F.R. 1.492(a)(1)-(5): <ul style="list-style-type: none"> -- Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 -- International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 -- International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO \$740.00 -- International preliminary examination fee (37 C.F.R. 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 -- International preliminary examination fee (37 C.F.R. 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 																						
ENTER APPROPRIATE BASIC FEE AMOUNT =		\$ 890.00																				
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).		\$ 130.00																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>CLAIMS</th> <th>NUMBER FILED</th> <th>NUMBER EXTRA</th> <th>RATE</th> </tr> </thead> <tbody> <tr> <td>Total Claims</td> <td>35</td> <td>-20 =</td> <td>X \$18.00</td> </tr> <tr> <td>Independent Claims</td> <td>1</td> <td>-3 =</td> <td>X \$84.00</td> </tr> <tr> <td colspan="2">MULTIPLE DEPENDENT CLAIMS(S) (if applicable)</td> <td colspan="2">\$280.00</td> </tr> <tr> <td colspan="2">CLAIM FEES ARE NOT BEING PAID AT THIS TIME</td> <td colspan="2">TOTAL OF ABOVE CALCULATIONS =</td> </tr> </tbody> </table>		CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	Total Claims	35	-20 =	X \$18.00	Independent Claims	1	-3 =	X \$84.00	MULTIPLE DEPENDENT CLAIMS(S) (if applicable)		\$280.00		CLAIM FEES ARE NOT BEING PAID AT THIS TIME		TOTAL OF ABOVE CALCULATIONS =		\$ 1290.00
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<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.		0.00																				
SUBTOTAL =		\$ 1290.00																				
Processing fee of \$130.00, for furnishing the English Translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(f)).		0.00																				
TOTAL NATIONAL FEE =		\$ 1290.00																				
Fee for recording the enclosed assignment (37 C.F.R. 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property		+ \$ 0.00																				
Fee for Petition to Revive Unintentionally Abandoned Application (\$1280.00 - Small Entity = \$640.00)		\$ 0.00																				
TOTAL FEES ENCLOSED =		\$ 1290.00																				
		Amount to be: refunded \$																				
		Charged \$																				
a. <input checked="" type="checkbox"/> A check in the amount of \$1290.00 to cover the above fees is enclosed.																						
b. <input type="checkbox"/> Please charge my Deposit Account No. 14-1140 in the amount of \$ _____ to cover the above fees. A duplicate copy of this form is enclosed.																						
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-1140. A <u>duplicate</u> copy of this form is enclosed.																						
d. <input checked="" type="checkbox"/> The entire content of the foreign application(s), referred to in this application is/are hereby incorporated by reference in this application.																						
NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.																						
SEND ALL CORRESPONDENCE TO:																						
NIXON & VANDERHYE P.C. 1100 North Glebe Road, 8 th Floor Arlington, Virginia 22201-4714 Telephone: (703) 816-4000																						
 SIGNATURE Leonard C. Mitchard NAME																						
29,009 March 8, 2002 REGISTRATION NUMBER Date																						
The PTO did not receive the following listed item(s) Received only \$10.20																						

10/070619

JC13 Rec'd PCT/PTO 08 MAR 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

MASSARA, A. et al.

Atty. Ref.: 2490-17

Serial No. unknown

Group:

Filed: March 8, 2002

Examiner:

For: SEMICONDUCTOR LASER DIODE WITH A DISTRIBUTED REFLECTOR

* * * * *

March 8, 2002

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

PRELIMINARY AMENDMENT

In order to place the above-identified application in better condition for examination, please amend the application as follows:

IN THE SPECIFICATION

Please substitute the following paragraphs in the specification for corresponding paragraphs previously presented. A copy of the amended specification paragraphs showing current revisions is attached.

Page 1, before the first line, please insert as a separate paragraph:

This application is the US national phase of international application PCT/GB00/03483 filed 08 September 2000, which designated the US.

MASSARA, A. et al.

Serial No. unknown

IN THE CLAIMS

Please substitute the following amended claims for corresponding claims previously presented. A copy of the amended claims showing current revisions is attached.

3. An optical device as claimed in claim 1, wherein the two-dimensional array is in a plane parallel to the active layer and extends to a depth comparable to that of the active layer.

4. An optical device as claimed in claim 1, wherein the individual elements are holes.

7. An optical device, as claimed in claim 4, wherein the holes extend to a depth comparable to that of the active layer in a direction that is perpendicular to the plane parallel to the active layer.

8. An optical device, as claimed in claim 4, wherein the holes extend to a depth comparable to that of the active layer in a direction that is not perpendicular to the plane parallel to the active layer.

9. An optical device, as claimed in claim 4, wherein the holes are regions of different refractive index to that of the device structure.

10. An optical device, as claimed in claim 4, wherein the holes are regions of different gain or loss to that of the device structure.

MASSARA, A. et al.

Serial No. unknown

22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

11. An optical device, as claimed in claim 3, wherein the distributed reflector does not pierce the active region.

12. An optical device, as claimed in claim 3, wherein the distributed reflector partially pierces the active region.

13. An optical device, as claimed in claim 3, wherein the distributed reflector fully pierces the active region.

14. An optical device, as claimed in claim 1, wherein the distributed reflector is within the device.

17. An optical device as claimed in claim 1, with means for varying the electrical bias or biases applied to the device to obtain efficient optical emission in single wavelength operation.

19. An optical device, as claimed in claim 1, which is integrated with separate amplifying, absorbing or passive sections.

21. An optical device, as claimed in claim 1, with means for being pulsed

MASSARA, A. et al.

Serial No. unknown

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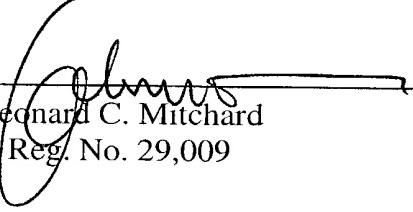
REMARKS

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page(s) is captioned "Version With Markings To Show Changes Made."

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____


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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

Page 1, before the first line, please insert as a separate paragraph:

This application is the US national phase of international application PCT/GB00/03483 filed 08 September 2000, which designated the US.

IN THE CLAIMS

3. An optical device as claimed in claim 1-~~or~~2, wherein the two-dimensional array is in a plane parallel to the active layer and extends to a depth comparable to that of the active layer.

4. An optical device as claimed in claim 1,~~2-~~or~~3~~, wherein the individual elements are holes.

7. An optical device, as claimed in ~~one of~~ claims 4-~~to~~6, wherein the holes extend to a depth comparable to that of the active layer in a direction that is perpendicular to the plane parallel to the active layer.

8. An optical device, as claimed in ~~one of~~ claims 4-~~to~~6, wherein the holes extend to a depth comparable to that of the active layer in a direction that is not perpendicular to the plane parallel to the active layer.

MASSARA, A. et al.

Serial No. unknown

9. An optical device, as claimed in ~~one of claims 4 to 8~~, wherein the holes are regions of different refractive index to that of the device structure.

10. An optical device, as claimed in ~~one of claims 4 to 9~~, wherein the holes are regions of different gain or loss to that of the device structure.

11. An optical device, as claimed in ~~one of claims 3 to 10~~, wherein the distributed reflector does not pierce the active region.

12. An optical device, as claimed in ~~one of claims 3 to 10~~, wherein the distributed reflector partially pierces the active region.

13. An optical device, as claimed in ~~one of claims 3 to 10~~, wherein the distributed reflector fully pierces the active region.

14. An optical device, as claimed in ~~any preceding claim 1~~, wherein the distributed reflector is within the device.

17. An optical device as claimed in ~~any preceding claim 1~~, with means for varying the electrical bias or biases applied to the device to obtain efficient optical emission in single wavelength operation.

MASSARA, A. et al.

Serial No. unknown

19. An optical device, as claimed in any preceding claim 1, which is integrated with separate amplifying, absorbing or passive sections.

21. An optical device, as claimed in a in any preceding claim 1, with means for being pulsed by gain switching, Q-switching or mode-locking techniques.

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WO 01/18924

SEMICONDUCTOR LASER DIODE WITH A DISTRIBUTED REFLECTOR

Laser devices are commonly used as light sources, and it is of particular interest to be able to obtain laser sources which have high quality spectral performance for data communication applications. It is of particular interest to be able to manufacture such devices in a relatively simple and low cost way, to achieve a robust device. In particular it is advantageous to achieve a device with a highly selective optical spectrum, that is, a device which produces a large amplitude peak at one specific wavelength of output light.

One type of laser device which can be used as such a source is a Distributed Feedback (DFB) laser, and the related Distributed Bragg Reflector (DBR) laser. However, conventional techniques for manufacturing such devices include regrowth steps, which make the manufacturing relatively expensive.

The paper "1.5 μ m wavelength DBR lasers consisting of 3 λ /4-semiconductor and 3 λ /4-groove buried with benzocyclobutene", M.M.Raj, J. Wiedmann, Y. Saka, H. Yasumoto and S. Arai. *Electronics Letter*, Vol.. 35, No. 16, pp. 1335-1337 describes a method of manufacturing deep etched (DBR) lasers. Since this technique involves etching into and across the active layer, the wave ceases to be guided within the etch, which means that these devices are likely to be inherently lossy.

The present invention relates to a laser device, with a ridge waveguide, with a distributed reflector on either side of the central ridge.

Since the light wave remains guided, this has the advantage that the device is relatively efficient.

Preferably, the reflector can be obtained by etching into the active layer on either side of the waveguide.

-2-

This has the advantage that the reflector can be obtained without using additional regrowth steps.

Preferably, the reflector takes the form of a two-dimensional pattern. This allows efficient reflection, while allowing the reflector to be contained in a relatively short length of the device.

For a better understanding of the present invention, and to show how it may be put into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a plan view of a laser device in accordance with the invention.

Figure 2 is an enlarged schematic illustration of a region of Figure 1.

Figure 3 is a cross-sectional view through the device of Figure 1.

Figure 4 illustrates the room temperature (20°C) CW optical spectra at 60mA for (a) pre-etch non-AR coated and (b) post-etch AR coated conditions of the device of Figure 1.

Figure 5 illustrates the post-etch room temperature (20°C) CW L-I characteristics of the device of Figure 1.

Figure 6 illustrates the post-etch, room temperature (20°C) variation of lasing wavelength with CW bias current for the device of Figure 1.

Figure 1 is a top plan view of a laser device in accordance with the invention. The device 2 is an InGaAsP-InP laser, with a ridge-waveguide 4. The device consists of seven 0.8% compressively strained quantum wells, and operates at a centre wavelength of $\sim 1.29\mu\text{m}$. The laser is $350\mu\text{m}$ long, and acts as a Fabry-Perot (F-P) laser. It is cleaved on both end facets 6,8. The laser is bonded junction side up on a temperature-controlled submount (not shown) and the output can be connected via a lensed fibre. The back

-3-

facet 6 is AR coated to 0.1%, in order to suppress the F-P modes.

Figure 3 is a cross-sectional view, taken on line A-A in Figure 1. As shown in Figure 3, the device has an active region 10 within the structure, with a silicon dioxide layer 12, having a metal layer 14 above it as the uppermost layers. The central ridge-waveguide has a width W of, for example, approximately 3 μm , with etched channels of width X of approximately 8 μm on either side of the ridge waveguide.

In accordance with the preferred embodiment of the invention, a distributed reflector structure is provided on either side of the central ridge waveguide, leaving the waveguide itself untouched.

In this illustrated embodiment of the invention, the distributed reflectors take the form of an etched 2D-lattice grating 18. The grating 18 is etched into the bottom surfaces 20 of the channels 16, over a section of the cavity. This section has a length L of approximately 50 μm , and is located towards the back facet 6 of the device, for example approximately 50 μm from the back facet.

Figure 2 is an enlarged view of the etched grating pattern in one of the channels 16. The array comprises a series of holes 22, etched through the top contact 14 to a depth which is comparable to the depth of the active region 10. In this illustrated embodiment, the holes 22 are arranged in a hexagonal array. That is, each hole away from the edge of the array is surrounded by six equally spaced holes. This separation a is of the order of 0.60-0.65 μm , and the holes have a radius r such that the radius-to-pitch ratio r:a is 0.17, although it may be in the range of 0.17-0.33.

The grating pattern could also be a square array, or any pattern which provides a suitable reflector.

Preferably, the holes are etched to a depth which

-4-

is very close to, or, more preferably, into the active region.

Advantageously, the holes can be obtained by post-processing using any available etching technique, for example, focused ion beam etching (FIBE) or reactive ion etching (RIE), without requiring any subsequent regrowth. This has the advantage that the device can be manufactured relatively simply and inexpensively.

This structure has the further advantage that the holes, which act as the reflectors, provide a high refractive index contrast ratio between the holes and the material of the device, of approximately 1:3.5.

In order to improve passivation, it is possible to fill in the etched holes with a suitable material, such as benzocyclobutene (BCB), which reduces this ratio to approximately 1.5:3.5. However, this ratio is sufficiently large that a highly selective characteristic can be obtained, over a short etched length.

The post-etch performance of the device is characterised in terms of the optical spectra. Measurements are taken at room temperature (20°C) under CW bias conditions. Figure 4a shows the pre-etch spectrum before AR coating at 60mA. This is indicative of a typical multi longitudinal mode F-P structure. Figure 4b illustrates clearly that, after etching, the device lases in a single longitudinal mode. Purely single mode operation is maintained over the entire operating current range up to over 3 times threshold. A typical SMSR value of >30dB is measured.

In order to investigate the stability of the lasting wavelength, the light current characteristics under CW bias conditions are measured at room temperature. Figure 5 shows a linear response above threshold, with no kinks evident, indicating that mode-hopping does not occur. A slope efficiency of 0.09 W/A

-5-

is measured along with an output power of greater than 2.5mW at twice threshold current. At room temperature, a reduction in threshold current of 2mA was observed as a result of the etch.

5 Single mode operation is further evidenced in Figure 6, which shows the variation of peak wavelength with CW bias current at room temperature (20°C). From threshold up to 85mA, the lasing wavelength is found to vary linearly at 0.009nm/mA, indicating mode-hop-free 10 operation. The device spectra remain single mode over this range. Single mode emission is found to vary at the rate of 0.08nm/°C around room temperature.

15 One possible use of the device of the invention is in an integrated device which has, say, four such laser sources on a single device, with the distributed reflector structures of the four sources being different, such that the integrated device can selectively provide a source at any of four wavelengths.

20 There is thus described a technique which allows manufacture of a single-contact, mode-hop-free single longitudinal mode laser operating CW at room temperature, and bit rates up to approximately 10 GHz, to be produced from a previously multi-mode Fabry-Perot 25 ridge-waveguide device.

- 6 -

CLAIMS:

1. An optical device, comprising a laser diode having a ridge waveguide located above an active layer, and having a distributed reflector in the form of a lattice of individual elements, wherein the elements are arranged in a two-dimensional array on either side of the ridge waveguide.

5 2. An optical device as claimed in claim 1, wherein the distributed reflector comprises a structure in material above the active layer on either side of the ridge waveguide.

10 3. An optical device as claimed in claim 1 or 2, wherein the two-dimensional array is in a plane parallel to the active layer and extends to a depth comparable to that of the active layer.

15 4. An optical device as claimed in claim 1, 2 or 3, wherein the individual elements are holes.

20 5. An optical device as claimed in claim 4, wherein the holes are arranged in a hexagonal array.

6. An optical device as claimed in claim 4, wherein the holes are arranged in a square array.

25 7. An optical device, as claimed in one of claims 4 to 6, wherein the holes extend to a depth comparable to that of the active layer in a direction that is perpendicular to the plane parallel to the active layer.

30 8. An optical device, as claimed in one of claims 4 to 6, wherein the holes extend to a depth comparable to that of the active layer in a direction that is not perpendicular to the plane parallel to the active layer.

35 9. An optical device, as claimed in one of claims 4 to 8, wherein the holes are regions of different refractive index to that of the device structure.

10. An optical device, as claimed in one of

-7-

claims 4 to 9, wherein the holes are regions of different gain or loss to that of the device structure.

5 11. An optical device, as claimed in one of claims 3 to 10, wherein the distributed reflector does not pierce the active region.

12. An optical device, as claimed in one of claims 3 to 10, wherein the distributed reflector partially pierces the active region.

10 13. An optical device, as claimed in one of claims 3 to 10, wherein the distributed reflector fully pierces the active region.

14. An optical device, as claimed in any preceding claim, wherein the distributed reflector is within the device.

15 15. An optical device, as claimed in claim 14, wherein the distributed reflector is within a pumped region.

20 16. An optical device as claimed in claim 14, wherein the distributed reflector is within an un-pumped region.

17. An optical device as claimed in any preceding claim, with means for varying the electrical bias or biases applied to the device to obtain efficient optical emission in single wavelength operation.

25 18. An optical device, as claimed in claim 17, wherein the emission wavelength may be controlled/tuned.

30 19. An optical device, as claimed in any preceding claim, which is integrated with separate amplifying, absorbing or passive sections.

20. An optical device, as claimed in claim 19, where the amplifying or absorbing sections have gain/loss modulation.

35 21. An optical device, as claimed in any preceding claim, with means for being pulsed by gain switching, Q-switching or mode-locking techniques.

AMENDED SHEET

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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(71) Applicant (for all designated States except US): UNIVERSITY OF BRISTOL [GB/GB]; 3rd floor, Senate House, Tyndall Avenue, Bristol BS8 1TH (GB).

(72) Inventors; and

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(74) Agent: O'CONNELL, David, Christopher; Haseltine Lake & Co., Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).

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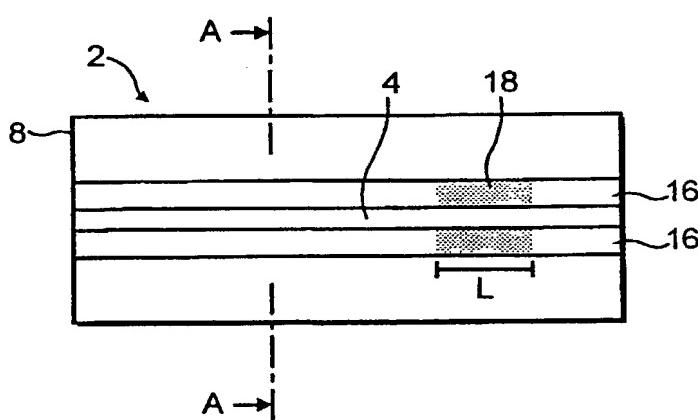
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SEMICONDUCTOR LASER DIODE WITH A DISTRIBUTED REFLECTOR



(57) Abstract: There is disclosed a laser diode with a ridge waveguide (14), in which a distributed reflector takes the form of an array of holes (22) etched into the surface of the device on either side of the central waveguide.

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PCT/GB00/03483

WO 01/18924

1 / 3

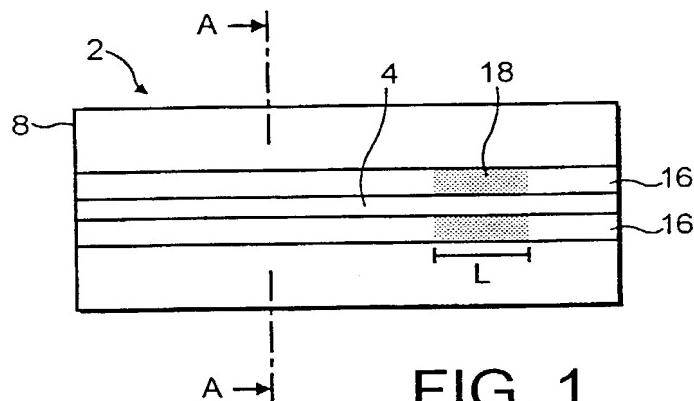


FIG. 1

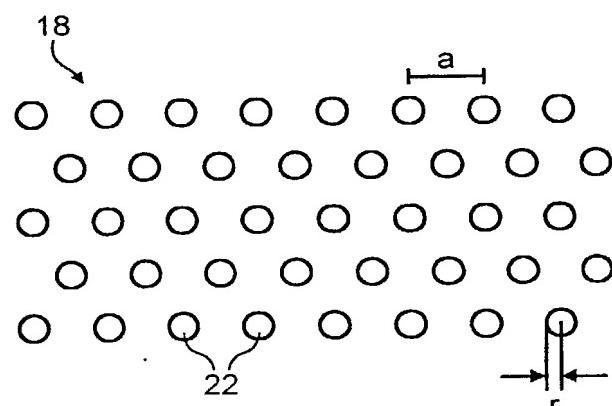


FIG. 2

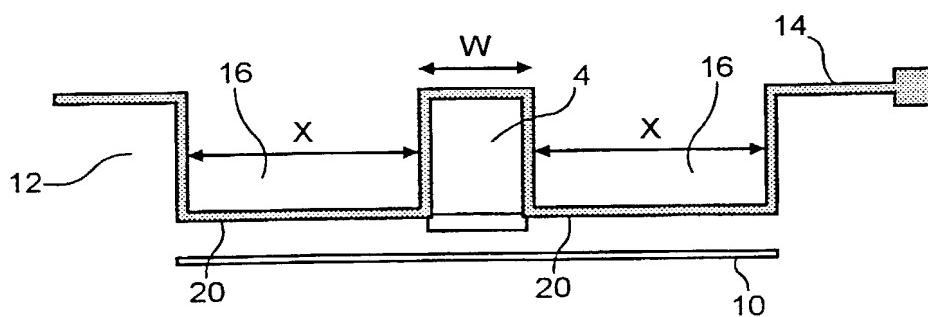


FIG. 3

2 / 3

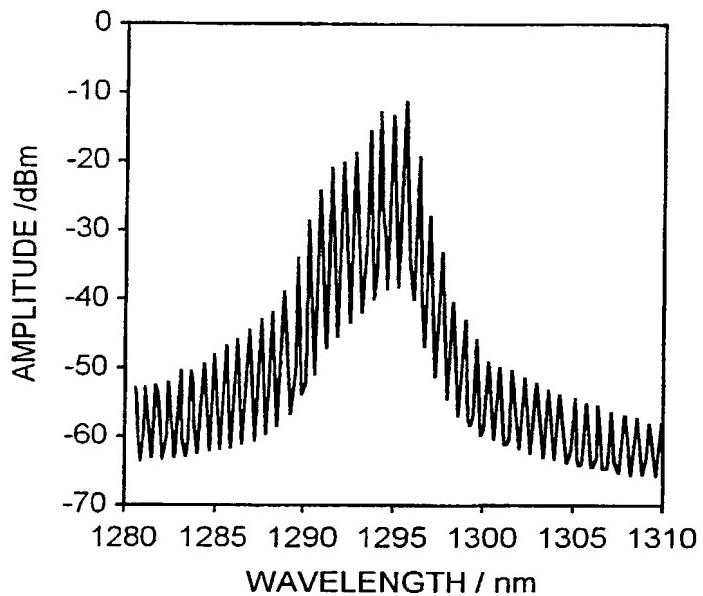


FIG. 4(a)

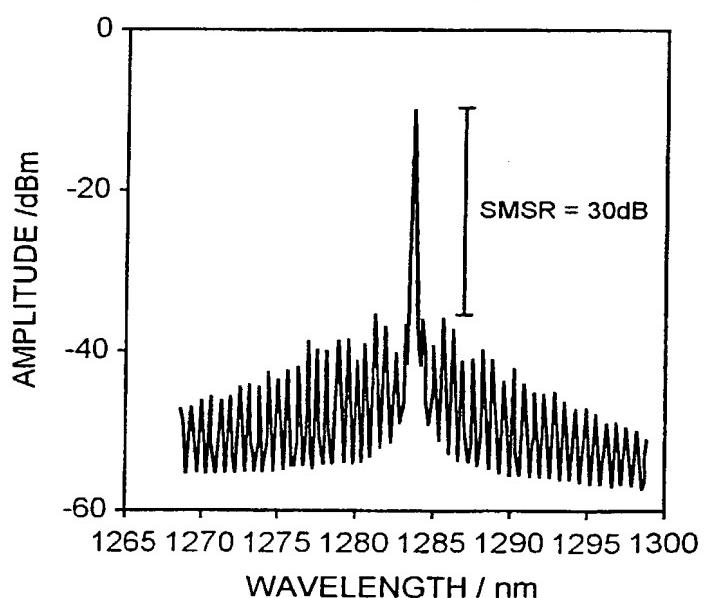


FIG. 4(b)

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WO 01/18924

PCT/GB00/03483

3 / 3

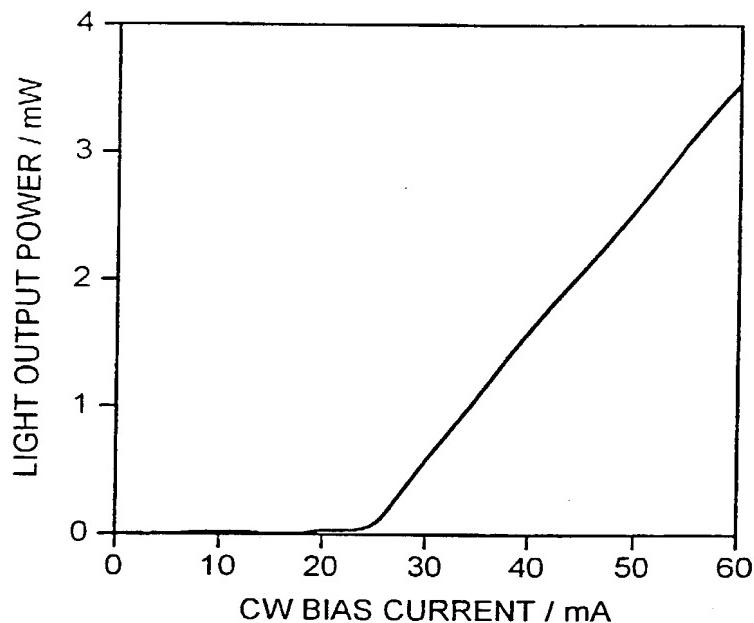


FIG. 5

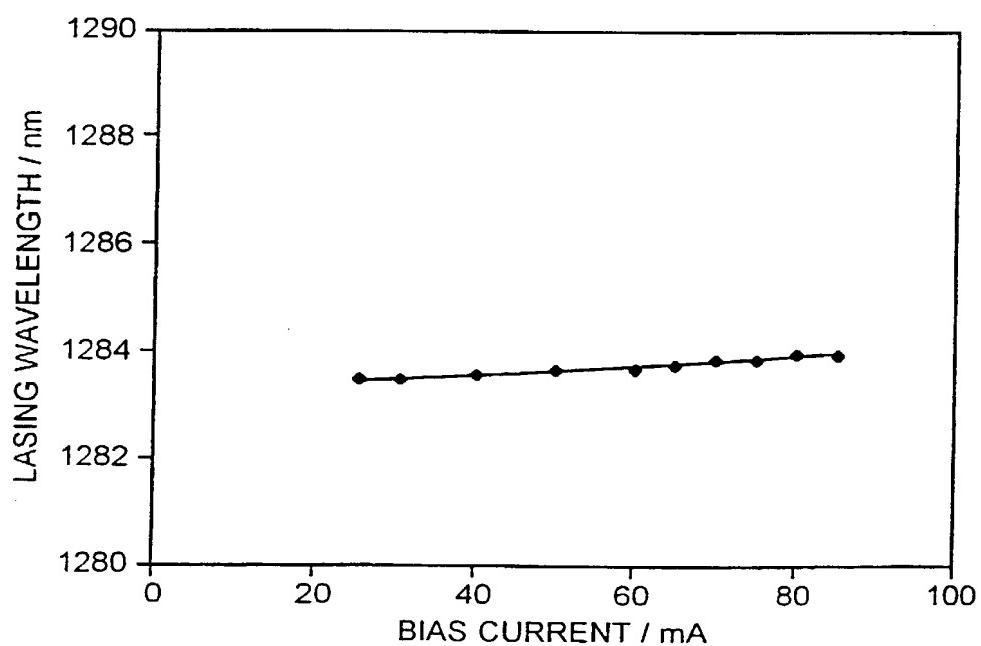


FIG. 6

2490-17
HL76966/002/DCO/JJMNixon & Vanderhye P.C. (10/99)
(Domestic Non-Assigned/Foreign) Page 1

RULE 63 (37 C.F.R. 1.63)

INVENTORS DECLARATION FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

As a below named inventor, I hereby declare that my residence, mailing address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SEMICONDUCTOR LASER DIODE WITH A DISTRIBUTED REFLECTOR

The specification of which (check applicable box(s)):

is attached hereto
 was filed on March 8, 2002 as U.S. Application Serial No. 10/070,619 (Atty Dkt. No. 2490-17)
 was filed as PCT International application No. PCT/GB00/03483 on 08/09/2000
 and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application:

Priority Foreign Application(s):

Application Number	Country	Day/Month/Year Filed
9921445.4	Great Britain	8 September 1999

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

Application Number	Date/Month/Year Filed
--------------------	-----------------------

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below:

Prior U.S./PCT Application(s):

Application Serial No.	Day/Month/Year Filed	Status: patented pending, abandoned
PCT/GB00/03483	08/09/2000	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby appoint NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000 (to whom all communications are to be directed), and the following attorneys thereof (of the same address) individually and collectively owner/owners' attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulling patent: Larry S. Nixon, 25640; Arthur R. Crawford, 25327; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mitchard, 29009; Duane M. Byers, 33363; Jeffry H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr. 29366; Mary J. Wilson, 32955; J. Scott Davidson, 33489; Alan M. Kagen, 36178; Robert A. Molan, 29834; B. J. Sadoff, 36663; James D. Berquist, 34776; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35329; Joseph A. Rhoa, 37515; Raymond Y. Mah, 41426; Chris Comuntzis, 31097; Gary T. Tanigawa, 43180. I also authorize Nixon & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions directly communicated from the person, assignee, attorney, firm, or other organization sending instructions to Nixon & Vanderhye on behalf of the owner(s).

1. Inventor's Signature: Aeneas Massara Date: 08/06/01
Inventor: /

<u>Aeneas</u>	<u>B</u>	<u>Massara</u>	Date: <u>08/06/01</u>
(first)	MI	(last)	British (citizenship)
<u>Essex</u>	<u>NORFOLK</u>	<u>GRX</u>	(state/country) <u>Great Britain</u>
<u>8 Gentwood Close, West Bergholt, Colchester, Essex, Great Britain</u>		<u>8 TUDOR AVENUE</u>	
<u>CO6 9SE</u>		<u>ROYDON, DISS NORFOLK NR9</u>	

2. Inventor's Signature: Laurence J. Sargent Date: _____
Inventor: /

<u>Laurence</u>	<u>J.</u>	<u>Sargent</u>	Date: _____
(first)	MI	(last)	British (citizenship)
<u>Marlow, Buckinghamshire</u>		<u>Great Britain</u>	
<u>'Esperie' Munday Dean, Marlow, Buckinghamshire, Great Britain</u>			
<u>SL7 3BU</u>			

See attached sheet(s) for additional inventor(s) information!!

09-AUG-2002 14:04 FROM HASELTINE LAKE

TO 0017038160122 IP-0903722

2490-17
Serial No. 10/070,619

Nixon & Vanderhye P.C. (10/99)
(Domestic Non-Assigned/Foreign)

Page 2

3. Inventor's Signature:

Inventor:	Richard (first)	V. MI	Perry (last)	Date:	British (citizenship)
Residence: (city)	Bristol		(state/country)	Great Britain	
Mailing Address: (Zip Code)	55 Redland Road, Bristol, Great Britain BS6 6AG				

4. Inventor's Signature:

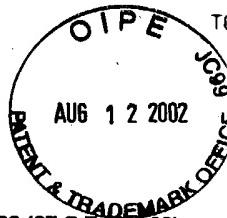
Inventor:	Ian (first)	H. MI	White (last)	Date:	British (citizenship)
Residence: (city)	Bath		(state/country)	Great Britain	
Mailing Address: (Zip Code)	57 Coombe Park, Weston, Bath, Great Britain BA1 3NH				

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09-AUG-2002 14:03 FROM HASLTINE LAKE

O I P E TO 201P03816100 CL 03 .. CL 1A.0503 CL 03

2490-17
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Nixon & Vanderhye P.C. (10/99)
(Domestic Non-Assigned/Foreign) Page 1

RULE 63 (37 C.F.R. 1.63)
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 was filed on March 8, 2002 as U.S. Application Serial No. 10/070,619 (Atty Dkt. No. 2490-17)
 was filed as PCT International application No. PCT/GB00/03483 on 08/09/2000
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Application Serial No.	Day/Month/Year Filed	Status: patented pending, abandoned
PCT/GB00/03483	08/09/2000	

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1. Inventor's Signature:

Inventor:	Aeneas (first)	B. MI	Massara (last)	Date: British (citizenship)
Residence: (city)	Essex			Great Britain
Mailing Address:	8 Garthwood Close, West Bergholt, Colchester	Essex, Great Britain		
(Zip Code)	CO6 3EA			

2. Inventor's Signature:

Inventor:	Laurence (first)	J. GBX	Sargent (last)	Date: 30/04/2002 British (citizenship)
Residence: (city)	Marlow, Buckinghamshire			Great Britain
Mailing Address:	'Espero' Munday Dean, Marlow, Buckinghamshire	Great Britain		
(Zip Code)	SL7 3BU			

See attached sheet(s) for additional inventor(s) information!!

614684

09-AUG-2002 14:04 FROM HASLTINE LAKE

TO 9017038164100 PL06 E P12

2490-17
Serial No. 10/070,619

Nixon & Vanderhye P.C. (10/89
(Domestic Non-Assigned/Foreign)

Page 2

3. Inventor's Signature:

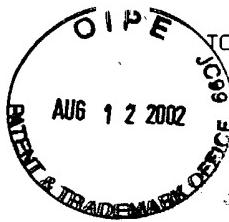
Inventor:	Richard (first)	V. MI	Penty (last)	Date:	British (citizenship)
Residence: (city)	Bristol				
Mailing Address: (Zip Code)	55 Redland Road, Bristol, Great Britain BS6 6AG		Great Britain		

4. Inventor's Signature:

Inventor:	Ian (first)	H. MI	White (last)	Date:	British (citizenship)
Residence: (city)	Bath				
Mailing Address: (Zip Code)	57 Coombe Park, Weston, Bath, Great Britain BA1 3NH		Great Britain		

614664

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2490-17
HL76968/002/DCO/JJM

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(Domestic Non-Assigned/Foreign) Page 1

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Priority Foreign Application(s):

Application Number	Country	Day/Month/Year Filed
8921445.4	Great Britain	8 September 1989

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Application Serial No.	Day/Month/Year Filed	Status: patented pending, abandoned
PCT/GB00/03483	08/09/2000	

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Residence: (city)	Essex		(state/country)	British (citizenship)
Mailing Address: (Zip Code)	8 Garthwood Close, West Bergholt, Colchester, Essex, Great Britain CO6 3EA			

2. Inventor's Signature:

Inventor:	Laurence (first)	J. MI	Sargent (last)	Date: _____
Residence: (city)	Marlow, Buckinghamshire		(state/country)	British (citizenship)
Mailing Address: (Zip Code)	'Espero' Munday Dean, Marlow, Buckinghamshire, Great Britain SL7 3BU			

See attached sheet(s) for additional inventor(s) information!!

09-AUG-2002 14:03 FROM HASLTINE LAKE

TO 00117038164100 1 12 12 12 12 12

2490-17
Serial No. 10/070,619

Nixon & Vanderhye P.C. (10/99)
(Domestic Non-Assigned/Foreign)
Page 2

3. Inventor's Signature:

Inventor:

Richard

V.

Penty

Date:

3/7/02

British
(citizenship)

Residence: (city)

Bristol CAMBRIDGE

GBX

(state/country)

Great Britain

Mailing Address:

55 Redland Road, Bristol, Great Britain

HOME FARM HOUSE, MEETING LANE,

(Zip Code)

B90 0AQ LITTLINGTON LANE, ROYSTON SG8 0QF LN

4. Inventor's Signature:

Inventor:

Ian

H.

White

Date:

British
(citizenship)

Residence: (city)

Bath

MI

(state/country)

Great Britain

Mailing Address:

57 Coombe Park, Weston, Bath, Great Britain

(Zip Code)

BA1 3NH

614664

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the specification of which (check applicable box(s)):

<input type="checkbox"/> is attached hereto	<input checked="" type="checkbox"/> was filed on <u>March 8, 2002</u>	as U.S. Application Serial No. <u>10/070,619</u>	(Atty Dkt. No. <u>2490-17</u>)
<input checked="" type="checkbox"/> was filed as PCT International application No. <u>PCT/GB00/03483</u>		on <u>08/09/2000</u>	

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Priority Foreign Application(s):

Application Number <u>9921445.4</u>	Country <u>Great Britain</u>	Day/Month/Year Filed <u>8 September 1999</u>
--	---------------------------------	---

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Application Number	Date/Month/Year Filed
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I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below:

Prior U.S./PCT Application(s): Application Serial No. <u>PCT/GB00/03483</u>	Day/Month/Year Filed <u>08/09/2000</u>	Status: patented pending, abandoned
---	---	-------------------------------------

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby appoint NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000 (to whom all communications are to be directed), and the following attorneys thereof (of the same address) individually and collectively owner's/owners' attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent: Larry S. Nixon, 25640; Arthur R. Crawford, 25327; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mritchard, 29009; Duane M. Byers, 33363; Jeffry H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr. 29366; Mary J. Wilson, 32955; J. Scott Davidson, 33489; Alan M. Kagen, 36178; Robert A. Molan, 29834; B. J. Sadoff, 36663; James D. Berquist, 34776; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35329; Joseph A. Rhoa, 37515; Raymond Y. Mah, 41426; Chris Comuntzis, 31097; Gary T. Tanigawa, 43180. I also authorize Nixon & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions directly communicated from the person, assignee, attorney, firm, or other organization sending instructions to Nixon & Vanderhye on behalf of the owner(s).

1. Inventor's Signature:	Inventor: <u>Aeneas (first)</u>	B. <u>MI</u>	Massara (last)	Date: _____
			<u>Great Britain</u>	(citizenship) <u>British</u>
Residence: (city)	<u>Essex</u>			
Mailing Address:	<u>8 Garthwood Close, West Bergholt, Colchester, Essex, Great Britain</u>			
(Zip Code)	<u>CO6 3EA</u>			

2. Inventor's Signature:	Inventor: <u>Laurence (first)</u>	J. <u>MI</u>	Sargent (last)	Date: _____
			<u>Great Britain</u>	(citizenship) <u>British</u>
Residence: (city)	<u>Marlow, Buckinghamshire</u>			
Mailing Address:	<u>'Espere' Munday Dean, Marlow, Buckinghamshire, Great Britain</u>			
(Zip Code)	<u>SL7 3BU</u>			

See attached sheet(s) for additional inventor(s) information!!

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2490-17
Serial No. 10/070,619

Nixon & Vanderhye P.C. (10/99)
(Domestic Non-Assigned/Foreign)
Page 2

3. Inventor's Signature:

Inventor:	Richard (first)	V. MI	Penty (last)	Date:
Residence: (city)	Bristol		(state/country)	British (citizenship)
Mailing Address:	55 Redland Road, Bristol, Great Britain		Great Britain	
(Zip Code)	BS6 6AG			

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Inventor:	Ian (first)	H. MI	White (last)	Date:
Residence: (city)	Bath	CAMBRIDGE	(state/country)	British (citizenship)
Mailing Address:	57 Coombe Park, Weston, Bath, Great Britain	40 NEW SQUARE, CAMBRIDGE, UK	Great Britain	
(Zip Code)	BA1 3NH	CB1 1E2		I. H. W.

GBX

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